

[0091] During handover the current procedures use the UE reported PCI to identify the handover target cell in the neighbor list. The following enhancements are proposed. If the UE reported PCI is in the neighbor list then the eNB performs enhanced checks including:

[0092] If the UE's AoA and UE Rx-Tx Time Difference are within the acceptable range to the information stored for this neighbor then handover is initiated to the corresponding target cell. If there are multiple entries for the reported PCI, then the neighbor with best AoA and UE Rx-Tx Time difference is selected.

[0093] If the UE's AoA and UE Rx-Tx Time Difference are not within the acceptable range to the information stored for this neighbor then the reported PCI is considered to belong to a different cell than the one in the neighbor list. The eNB then performs ANR procedures to determine the associated target cell Id. Based on the target cell id retrieved using ANR procedure the following actions can be performed:

[0094] If the target cell Id matches the stored information in the neighbor list then the stored AoA and UE Rx-Tx Time Difference is appended to the neighbor. The additional AoA/UE Rx-Tx Time Difference info can be used for future PCI translations.

[0095] If the target cell does not match the already stored in the neighbor list then new neighbor list entry is created with PCI, Target Cell ID, AoA and UE Rx-Tx Time Difference.

[0096] Overtime the neighbor list is updated with Uplink AoA for the UE and Rx-Tx Time Difference for the UE.

[0097] This invention allows the network with PCI confusion to continue to operate with no degradation to end user experience and improve handover success rate. This invention also allows the operator to de-prioritize the complex PCI confusion resolution. The exemplary embodiments of the invention provide at least benefits to:

[0098] increase the handover success rate when the PCI confusion exists in an area;

[0099] reduce the need of resolving PCI confusions if and when arises;

[0100] provide more flexibility to the operator to deploy small cells/Femtos with relaxed PCI planning rules (allowing PCI confusion); and

[0101] allows fast deployment of cell setup for special events (cell on wheels).

[0102] The exemplary embodiments of the invention can work to address PCI confusion issues in at least legacy 3GPP, LTE and CDMA operator networks where SON is supported. In SON networks, at least interfaces S1 and X2 are dynamically configured, as well as an IP address and connection to an IP backhaul. To reduce manual work ANR is used. ANR can be used to configure neighbor lists in newly deployed eNBs and for optimizing a list configuration during operation. Dynamic configuration includes the configuration of the Layer 1 identifier, Physical cell identity (PCI) and Cell global ID (COID). In SON networks the PCI can be assigned either in a centralized or distributed way. When centralized assignment is used the OAM system will have knowledge and control of the PCIs. When a distributed solution is used the OAM system assigns a list of possible PCIs to the newly deployed eNB, but the adoption of the PCI is in control of the eNB. The newly deployed eNB will request a report, sent either by User Equipment (UEs) over the air interface or by other eNBs over the X2 interface, including already in-use

PCIs. The eNB can randomly select its PCI from the remaining values. Thus, in a SON network an eNB such as the eNB 200 and/or eNB 220 of FIG. 2 may utilize the method in accordance with the exemplary embodiments to overcome PCI confusion issues. In accordance with the exemplary embodiments of the invention an eNB such as the eNB 200 and/or eNB 220 of FIG. 2 may operate in the SON network to dynamically populate the NRT with the AoA and/or UE Rx-Tx Timing as neighbors are learned of in the SON network.

[0103] FIG. 7 shows one method in accordance with the exemplary embodiments as described herein when it is determined that there is no PCI confusion in the NRT. As shown in FIG. 7 at step 710 a UE has reported a PCI of a cell and there is no PCI confusion in the NRT. Then at step 720 there is performed a check to determine if an AoA and/or UE Rx-Tx Timing measured for the UE meets range requirements for a handover based on information stored in NRT for the reported PCI. If as in step 725 the range is not met then at step 730 a ANR operation is performed to determine the target cell for the reported PCI. At step 740 it is determined whether the reported PCI maps to a new target cell. If no, then at step 745 the handover is performed to the cell with the PCI already stored in the NRT, and the PCI entry in the NRT is appended with at least the AoA and/or UE Rx-Tx Timing of the UE. If yes, then at step 750 the information of the new target cell is added to the NRT and the handover is performed using the new target cell with the AoA and/or UE Rx-Tx Timing of the UE. If as in step 728 the range is acceptable at step 760 the handover is performed. If the handover fails as shown in step 770 there may be tuning of at least the AoA and/or UE Rx-Tx Timing information in the NRT. Then at step 780 a correction to the stored AoA and/or UE Rx-Tx Timing information is applied and updated in the NRT. This prevents future handover operations to the PCI with AoA and/or UE Rx-Tx Timing information measured for the UE which encountered handover failure.

[0104] FIG. 8 shows a method in accordance with the exemplary embodiments as described herein when there is PCI confusion in the NRT. As shown in FIG. 8 at step 810 a UE has reported a PCI of a cell and it is determined that there is PCI confusion in the NRT. Then at step 820 there is performed at least an AoA and/or UE Rx-Tx Timing information check of the UE to determine whether the AoA and/or UE Rx-Tx Timing information is in an acceptable range stored for the same PCI already in the NRT. If as in step 825 the AoA and/or UE Rx-Tx Timing information of a target in the NRT is not in an acceptable range then at step 830 a ANR operation is performed to try to identify the new target cell for the reported PCI. At step 840 it is determined whether the new target cell is identified for the NRT. If no, then at step 845 the handover is performed to the cell with the PCI already stored in the NRT, and the PCI entry in the NRT is appended with at least the AoA and/or UE Rx-Tx Timing information measured for the UE. If yes, then at step 850 the identified new target cell is added to the NRT and AoA and/or UE Rx-Tx Timing information is entered in the NRT for the new target cell. If as in step 828 the AoA and/or UE Rx-Tx Timing information is in an acceptable range of a target in the NRT then at step 860 the handover is performed. If the handover fails as shown in step 870 there may be tuning of at least the AoA and/or UE Rx-Tx Timing information in the NRT. Then at step 880 a correction to the stored AoA and/or UE Rx-Tx Timing information is applied and updated in the NRT. This prevents future handover operations to the PCI with AoA